

# GEOLOGIST CREW ASSIGNMENTS DURING DELAYED COMMUNICATION HUMAN EXPLORATION



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# INTRODUCTION

- **Desert Research And Technology Studies (DRATS) 2011 test**
  - Evaluate operational modes at microgravity targets
  - Simulate delayed communications during human EVAs
- **Test Vehicles included**
  - Multi-Mission Space Exploration Vehicles
  - Deep Space Habitat



# BACKGROUND

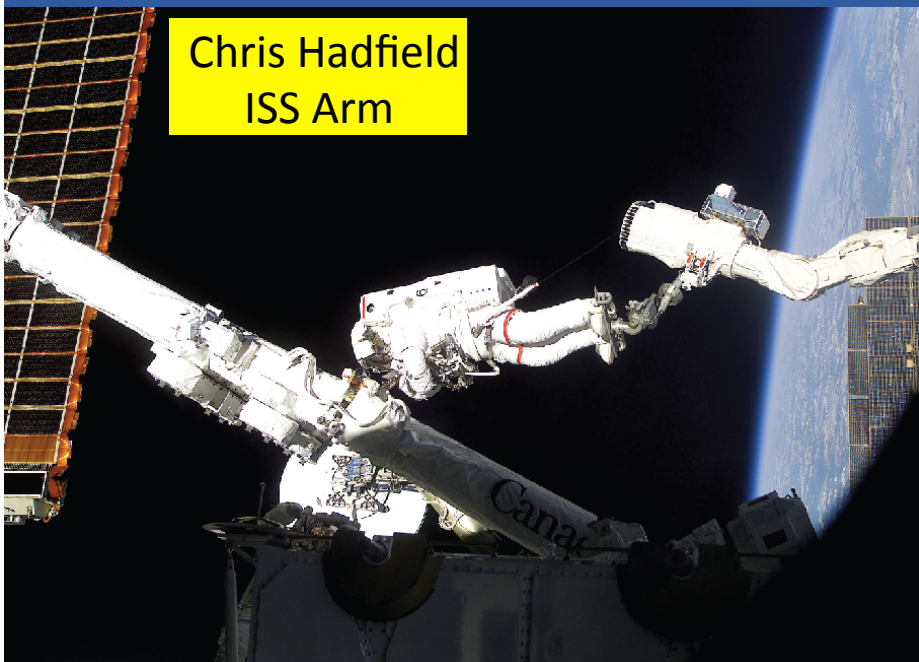
- EVA mobility included:
  - “Super” Simplified Aid for EVA Rescue (SSAFER)
  - Astronaut Positioning System (APS)



DRATS  
SSAFER



Mark Lee  
SAFER



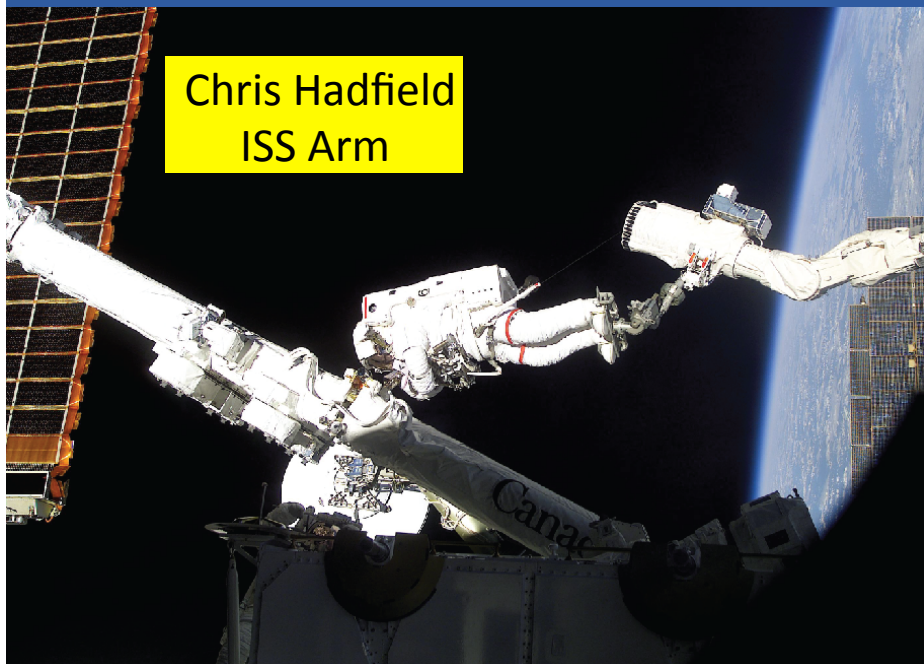
Chris Hadfield  
ISS Arm



DRATS APS

# LESSONS LEARNED

- 1 G environment not great to microgravity operations tests
- Comm delay highly disruptive to backroom contribution (*Love & Reagan, 2013*)



# CREW ASSIGNMENTS

- Meaningful results related to crew (geologist) assignments and delayed communications operations

- Condition 4
  - 2 EVA (no SEV)
  - 1 in DSH

No  
SEV

3  
Crew

- Condition 5
  - 2 in SEV
  - 1 in DSH

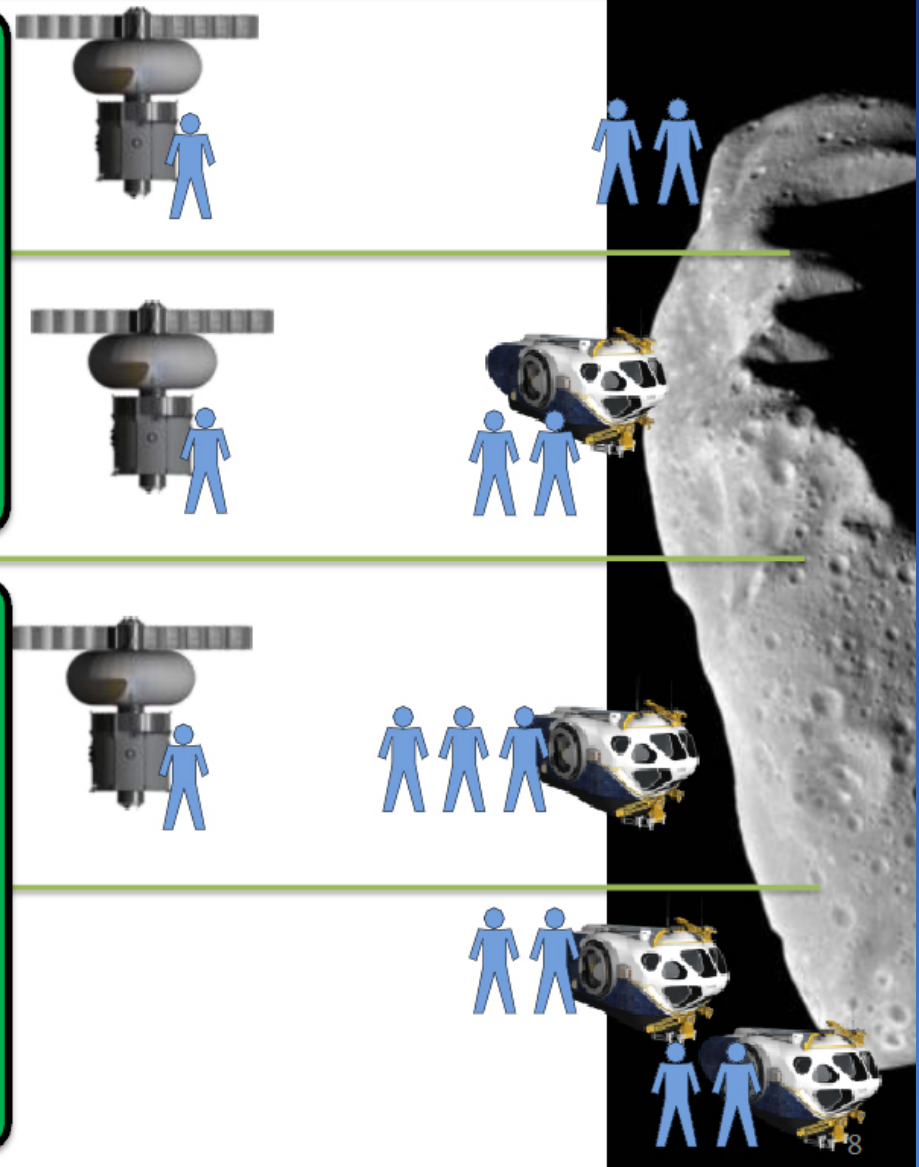
1  
SEV

4  
Crew

- Condition 6
  - 3 in SEV
  - 1 in DSH

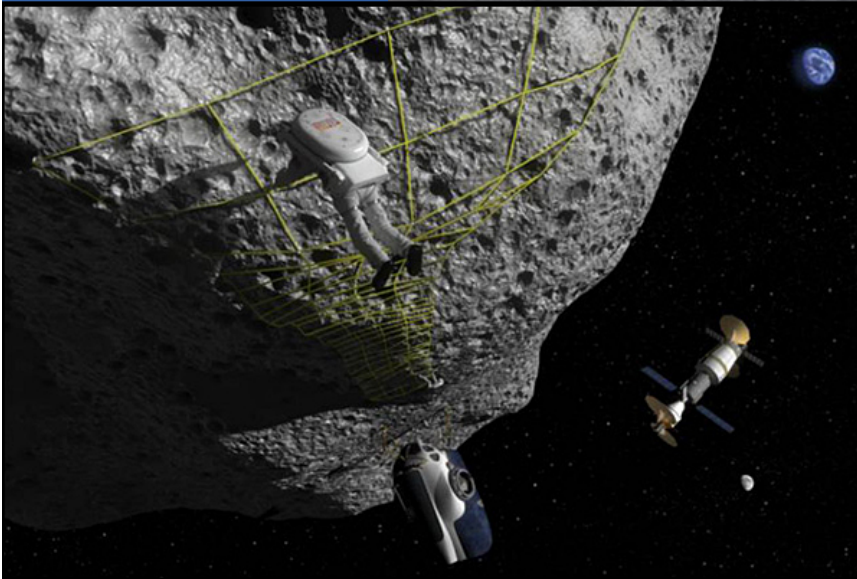
2  
SEVs

- Condition 7
  - 2 in each of 2 SEVs
  - 0 in DSH



# CREW ASSIGNMENTS

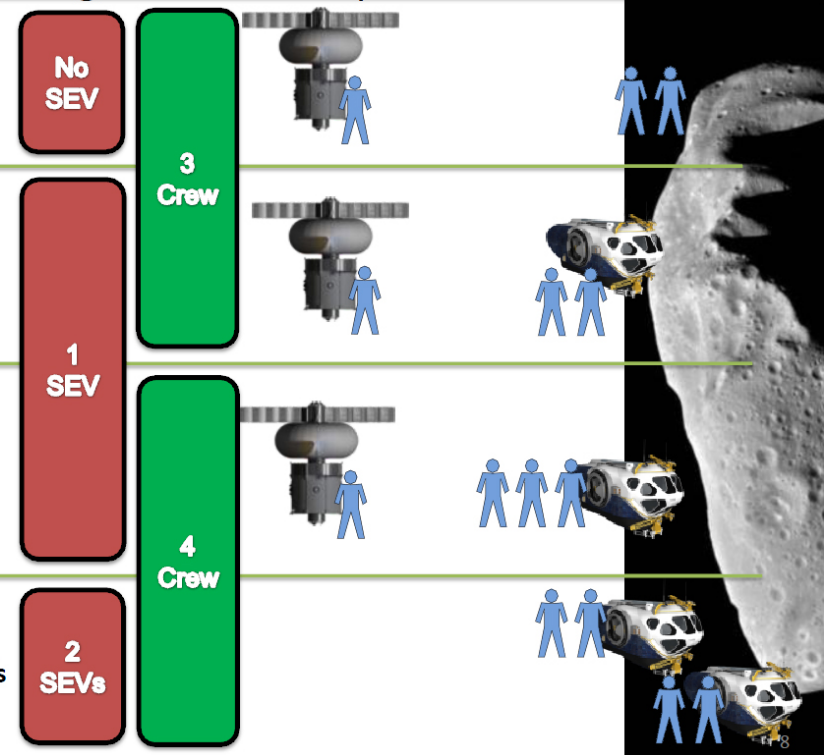
- Relevant lessons regardless of target
- Dependent on manner in which assets might be used



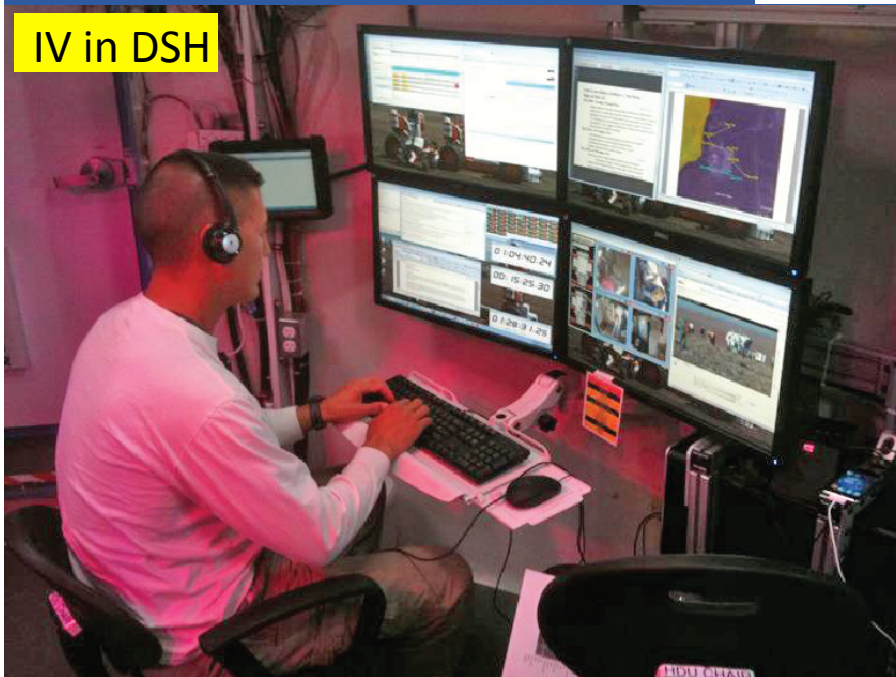
# ASSIGNMENTS

- Tested use of 3 and 4 crewmembers
- EVA crew interacted with Internal Vehicular (IV) crew
- IV crew used text messaging with Houston and voice with EVA crew

- Condition 4
  - 2 EVA (no SEV)
  - 1 in DSH
- Condition 5
  - 2 in SEV
  - 1 in DSH
- Condition 6
  - 3 in SEV
  - 1 in DSH
- Condition 7
  - 2 in each of 2 SEVs
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IV in DSH



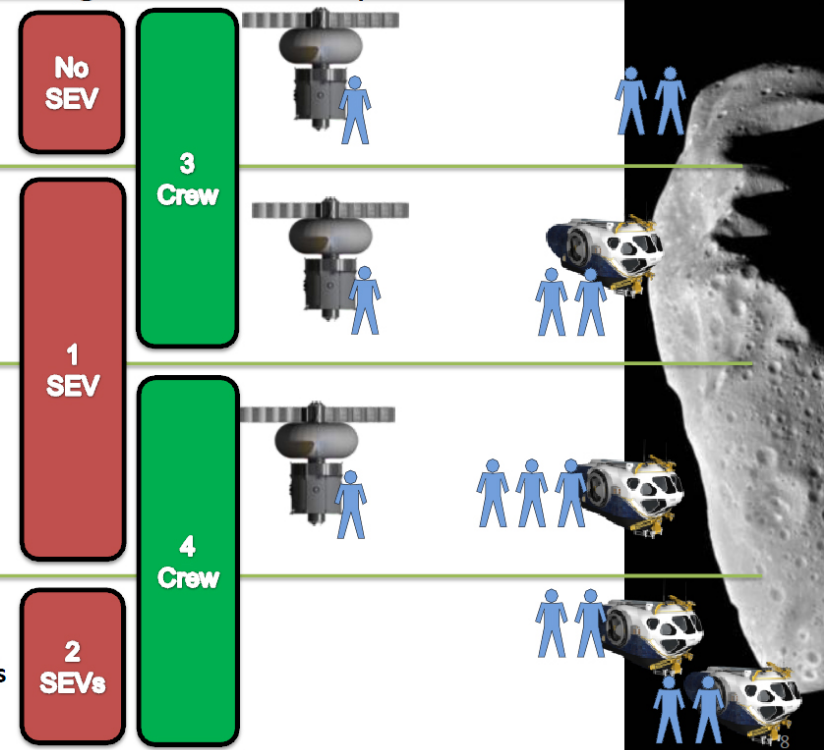
IV in MMSEV



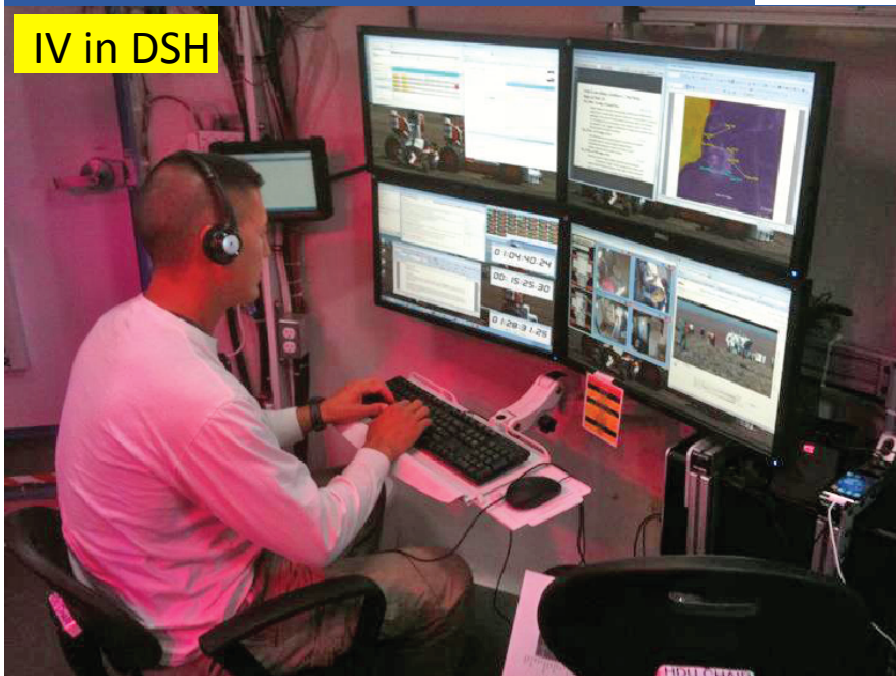
# ASSIGNMENTS

- Trained geologists and astronauts rotated through each role
- Science team *assumed* best place for geologist would be “boots on ground”

- Condition 4
  - 2 EVA (no SEV)
  - 1 in DSH
- Condition 5
  - 2 in SEV
  - 1 in DSH
- Condition 6
  - 3 in SEV
  - 1 in DSH
- Condition 7
  - 2 in each of 2 SEVs
  - 0 in DSH



IV in DSH



IV in MMSEV

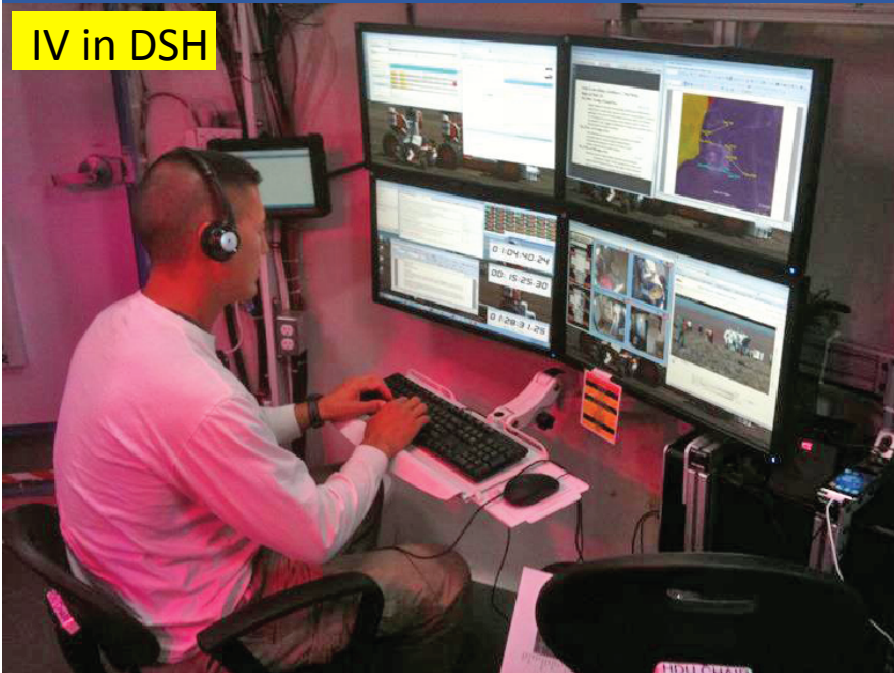


# ASSIGNMENTS

- All crew identified IV role as most critical during delayed communication operations
- All agreed that IV role requires additional testing
- IV handled delayed comm with JSC removing burden from EVA crew



IV in DSH



IV in MMSEV



# OBSERVATIONS

- Astronaut crewmembers often default to geologist as “science commander” once EVA begins (*Love & Bleacher, 2013*)
- Geologist crew served as “Field Science PI”
- Sample collection and documentation is time consuming task (*Hurtado et al., 2013*), especially in microgravity
- Geologists use too much time describing things (*Love & Bleacher, 2013*)



# ASSIGNMENTS

- Geologists were most valuable in IV role
- Provided geologist with access to all crew member's data
- Time consuming sample documentation conducted by astronaut while geologist planned next move
- Effectively enabled “expertise multiplication”
- Geologist most effective from MMSEV cockpit with eyes on ground

IV in MMSEV



IV in DSH



# RECOMMENDATIONS

- Further testing focused on IV role
- Unless threat of L of Mission, JSC should not communicate directly with EVA crew
- IV crew should handle delayed communications
- Trained scientist serves as field PI for team
- Scientist most effective in IV role
- EVA crew assignments must be flexible and should be decided upon by Mission Commander

IV in MMSEV



IV in DSH



